

unclassified

SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION unclassified			1b. RESTRICTIVE MARKINGS		
2a. DISTRIBUTION / AVAILABILITY STATEMENT DTIC AD-A209 611 JUN 22 1989 D			3. DISTRIBUTION / AVAILABILITY OF REPORT No restriction		
6a. NAME OF PERFORMING ORGANIZATION Delco Systems Operations			7a. NAME OF MONITORING ORGANIZATION General Dynamics		
6b. ADDRESS (City, State, and ZIP Code) Goleta, CA 93117			7b. ADDRESS (City, State, and ZIP Code) Fort Worth, TX 76107		
8a. NAME OF FUNDING / SPONSORING ORGANIZATION F-16 SPO		8b. OFFICE SYMBOL (if applicable) ASD		9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER Contract#F33657-82-C-2034 P.O.#1005206	
8c. ADDRESS (City, State, and ZIP Code) Dayton, OH 45433		10. SOURCE OF FUNDING NUMBERS			
		PROGRAM ELEMENT NO.		PROJECT NO.	TASK NO.
					WORK UNIT ACCESSION NO.
11. TITLE (Include Security Classification) Phase 2 Final Project Report - #7 Part Forming and Tinning (Surface Component Preparation)					
12. PERSONAL AUTHOR(S)					
13a. TYPE OF REPORT Final		13b. TIME COVERED FROM 1984 TO 1987		14. DATE OF REPORT (Year, Month, Day) 87.02.28	
15. PAGE COUNT 28					
16. SUPPLEMENTARY NOTATION CDRL ITM-004					
17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)		
FIELD	GROUP	SUB-GROUP	Automatic Part forming		
13	08				
19. ABSTRACT (Continue on reverse if necessary and identify by block number)					
<p>The proposed forming and tinning station will be fully automated, requiring only one operator to load and unload magazines and to oversee the station to ensure proper functions. The forming and tinning machine will prepare both leadless chip carriers (LCCs) and leaded flat packs by removing parts from incoming carriers, forming, tinning, and replacing the parts in carriers and reassembling the carriers into magazines.</p> <p><i>machine part, manufacturing production. JTS</i></p>					
<div style="border: 1px solid black; padding: 5px;"> <p>DISTRIBUTION STATEMENT A</p> <p>Approved for public release Distribution Unlimited</p> </div>					
20. DISTRIBUTION / AVAILABILITY OF ABSTRACT <input checked="" type="checkbox"/> UNCLASSIFIED/UNLIMITED <input type="checkbox"/> SAME AS RPT. <input type="checkbox"/> DTIC USERS			21. ABSTRACT SECURITY CLASSIFICATION unclassified		
22a. NAME OF RESPONSIBLE INDIVIDUAL Captain Curtis Britt			22b. TELEPHONE (Include Area Code) 513-258-4263		22c. OFFICE SYMBOL YPTM

DD FORM 1473, 84 MAR

83 APR edition may be used until exhausted.

All other editions are obsolete.

SECURITY CLASSIFICATION OF THIS PAGE
unclassified

89 6 20 140

28 February 1987

262014R
DE 89-0340

INDUSTRIAL TECHNOLOGY MODERNIZATION

Phase II Final Report
Project 7
Part Forming & Tinning




Prepared for
GENERAL DYNAMICS
Fort Worth, Texas

Contract No. F33657-82-C-2034

 **Delco
Systems
Operations**

DELCO ELECTRONICS CORPORATION
Goleta, California 93117

Accession For	
NTIS (RA&I)	<input checked="checked" type="checkbox"/>
DTIC TAB	<input type="checkbox"/>
Unannounced	<input type="checkbox"/>
Justification	
By 	
Distribution	
Availability Codes	
Dist	Avail and/or Special
A-1	

28 February 1987

INDUSTRIAL TECHNOLOGY MODERNIZATION

Phase II Final Report
Project 7
Part Forming & Tinning



Prepared for
GENERAL DYNAMICS
Fort Worth, Texas

Contract No. F33657-82-C-2034



DELCO ELECTRONICS CORPORATION
Goleta, California 93117

FINAL REPORT

CATAGORY I PROJECT 7

PART FORMING AND TINNING MACHINE

NOTE: FOLLOWING THE INITIAL INVESTIGATION,
TINNING WAS FOUND TO BE A NON-VIABLE
ITEM AND WAS SEPERATED FROM THIS
TASK AND DEFINED AS A SEPERATE ITEM.

THE APPROPRIATE TITLE FOR THIS
PROJECT IS:

PART FORMING MACHINE

REPORT BASIS:

This Final Report is prepared following the guide lines for a Catagory I Type Project. This project was entirely researched, designed, developed and fabricated with Delco Electronic's Div. of General Motors funding.

Being a Catagory I Type Project without support funding from the ITM Program, the following Final Report is condensed as opposed to a typical Catagory II Type Project.

OBJECTIVE:

Initial objective was to provide a method for preparation of flatpacks, quadpacks, and leadless chip carriers as follows:

1. Dispense the parts from vendor carriers.
2. Flux one, two or four sides as required.
3. Tin the leads or metalized surfaces.
4. Clean the parts.
5. Form leads on flatpack & quadpacks to numerous configurations.
6. Load the parts into Delco designed carriers.
7. Load the carriers into magazines.

The magazines of prepared parts would then be used to feed the ATS Pick and Place Machine.

TECHNICAL APPROACH:

The fluxing, tinning and cleaning operations were intended to use mechanical minipulators and hand the part off from one operation to the next. The actual die forming operation was to provide sensing for the lead exit point on the part and the machine would form the part feet with respect to the bottom of the case.

The basic machine would require a cycle time 5 seconds per part.

Form configurations would require twelve (12) toe to toe cut off dimensions.

Quick change over, (5 minutes) or less, is required from one part type and form configuration to the next.

4. Quadpacks would be hand fluxed, hand tinned, washed and then manually fed one at a time to the forming machine. Due to the low volume of these parts, automatic feeding was not required.

5. The statement of work was revised to reflect this approach and R.I.S.I. was put on contract to provide equipment for forming, loading carriers and magazines with this concept.

4. PRELIMINARY COST BENEFIT ANALYSIS:

a. Results of this "Reduced Scope" approach, resulted in an acceptable R.O.I. with and estimated savings per typical assembly with 100 parts:

	<u>OLD METHOD</u>	<u>NEW METHOD</u>
1. Hand tinning & cleaning (no change)	.659 Hours	.659 Hours
2. Forming on tape strips	.269 Hours	.120 Hours

b. In addition to reducing the actual forming cost the parts are loaded in carriers & magazines to feed the Pick and Place Machine (Project 1).

5. PRELIMINARY DESIGNS:

Preliminary designs for two machines were provided by R.I.S.I.

a. One machine was designed for Delco carriers, 1 1/4" square, with six interchangeable forming dies for all flatpacks with a range of 10 to 28 leads.

b. One machine was designed for Delco carriers, 2" square, with five interchangeable dies for all flatpacks exceeding 28 leads and all quadpacks.

c. Basic machine description (both machines are identical except for part sizes):

1. Body symetry is controlled to $\pm .005$.

2. Actual form die's were defined by Delco.

3. Floating anvils were used to sense the lead exit point on the part and provide the form with respect to the bottom of the case.
4. Carriers are fed automatically, loaded and stacked in a magazine.
5. Parts presence sensing is provided on the incoming parts, at the die and in the loaded carriers.
6. Suitable alarms for failing to pick-up a part at points in the operation are provided.
7. Feeders:
 - a. Tape strip feeder permits feeding the parts, pre-tinned on a piece of tape. The part is cut out of the tape, centered, formed, loaded in the carrier and then a magazine.
 - b. Magazine feeder permits feeding pre-tinned parts in carriers from a magazine. Part is removed from the carrier, centered, formed, loaded in another carrier and a magazine.

6. FINAL DESIGN:

Final machine design review was completed at RISI. Machine was fabricated and preliminary checkout was performed at RISI.

7. IMPLEMENTATION & REVIEW OF THE PROBLEMS.

- a. Machine was set-up in a lab environment in Oct/Nov of 1985. Production hardware in low volumes were run from Jan 85 to the present with numerous problems as defined below.
- b. Forming machine problems:
 1. Anvil sticking problem in the die sets was one major item which effects the downtime and efficiency. Recognizing that this is an oversimplification of both the problem and the solution, following is a description summary.

- a. The apparent cause of the anvil sticking problem is related to forming pre-tinned parts. The relatively soft composition of the tin/lead is carried into the die clearances and after 16 to 24 hours of operation the dies become sticky, and non-repeatable.
- b. Review with the vendor indicated they have never had an application to form after tinning. Because moving the tinning application is an undesirable change in our process we decided to revise the die mechanism.

To resolve this problem, a die redesign has been initiated to mechanically drive the floating anvils to the home position and at the same time "strip" the part out of the die. This is a positive repositioning step as opposed to a light spring return on the anvils. The new die designs will be in tryout in March 1987.

2. Second major problem effecting efficiency of the machine is related to the tape, tape feeder and control of the adhesive on the tape. This problem has caused a machine interruption every few minutes.
 - a. Accuracy of the punched holes in the tape did not meet the design tolerances and numerous contacts and tape fabrication die revisions were required. The in-accuracy of these "spocket" holes manifested into a machine tape feeding problem.
 - b. Application of adhesive to the tape is also a tape manufacturing problem. Seepage of the adhesive beyond the part case periphery resulted in jams at the machine tape cut off die.
 - c. Final problem associated with 'tape presented parts' was related to the stability of the tape mylar carrier. Mylar carrier does not remain stable thru the hand fluxing, tinning and cleaning processes.

Solution for this item is a revision to the tape. Tape has been redesigned for improved hole size & hole positioning accuracy. The positioning of adhesive has been revised to resolve the adhesive seepage problem. Mylar carrier has been revised from a .005 to a .010 film. New tape (five different P/N's) will be in tryout in March of 1987.

8. GROUP TECHNOLOGY TRANSFER:

Detailed design of this forming machine may be obtained from:

R.I.S.I. Industries, Inc.
798 "F" Street
P. O. Box 1356
Chula Vista, CA 92010

9. FINAL COST BENEFIT ANALYSIS:

- a. Cost benefit analysis of Project 7 with the above problems resulted in a negative savings. It should be further stated that any forming problems encountered in Project #7 also have a negative impact on the Project #1, Pick and Place Machine savings.
- b. Further it is anticipated that with resolution of the problems noted, the cost savings projected in item 4.a.2. will be realized in the June, 1987 time frame. Additional cost reductions will not occur until tinned parts are presented in carriers to this machine. Automatic tinning was added as a Phase II development which is not part of this report.

EXPLANATION OF TECHNICAL APPROACH TASKS:

1. Existing methods prior to this effort were entirely manual as follows:

- a. Flatpacks:

1. Parts are dispensed on double sided tape and centered on the tape in rows.
 2. Tape strips of parts were hand dipped in flux followed by a hand dip in a solder pot for tinning, one strip of 9 to 13 parts at a time.
 3. Strips of tape were placed on a tray with each tray containing parts to support a batch of ten circuit boards (approximately 100 strips of tape with 1200 parts).
 4. Trays of parts were then cleaned in an aqueous cleaner.
 5. The strips of parts were then formed in dies, one strip of 9 to 12 parts at a time. Different dies were used for different form/cut lengths.
 6. Tray of parts was sent to the assembly area for a kit batch of ten assemblies.

- b. Quadpacks were manually handled one at a time thru the same general process.

- c. Leadless chip carriers were tinned via a solder transfer method.

1. A titanium plate was screened with solder paste footprints matching the parts.
 2. Parts were hand assembled to the titanium plate via a tooled nesting fixture to locate the parts.
 3. Titanium plates with parts were then vapor phase soldered to transfer the solder from the plate to the part metalized surfaces.
 4. Parts were cleaned in a solvent degreaser in a basket and then sent to the assembly area.

2. Industry/Vendor Survey was initiated based on the automated approach, previously described.

1. Virtually no available equipment was found to handle the proposed approach.
2. In a 2nd try, a research firm was employed to search for available technology. Again this effort failed to locate existing full capability. This research did locate a firm with forming capability needed for this task, and three potential "Special Machine Tooling Firms".

3. PROPOSED TECHNICAL APPROACH:

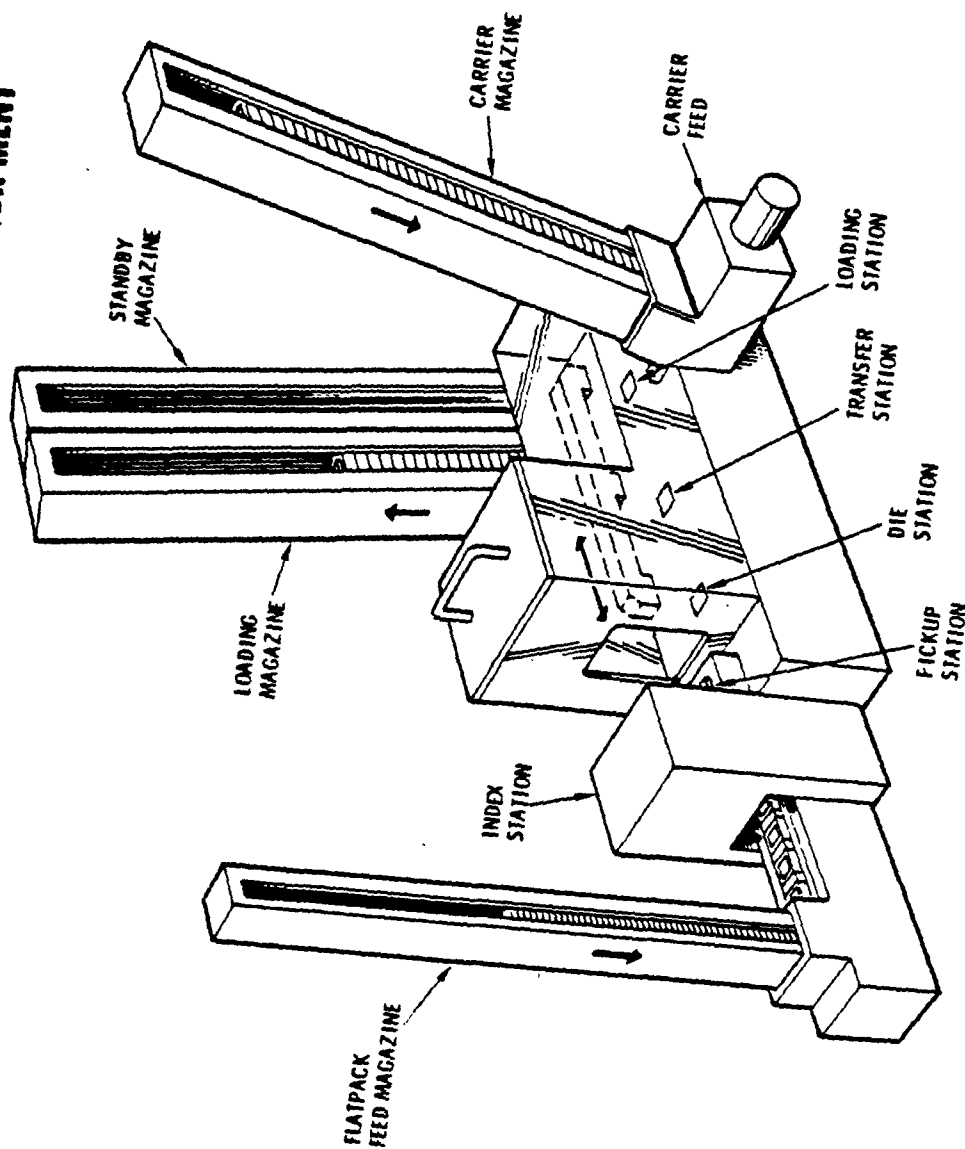
- a. Detailed statement of work was prepared and submitted to the three potential candidates (Weldun, R.I.S.I. and J. M. Sales Company. (See Attached)
- b. Quotations for a complete Turnkey System for tinning and forming:

Weldun - following considerable effort "No Bid" the job.

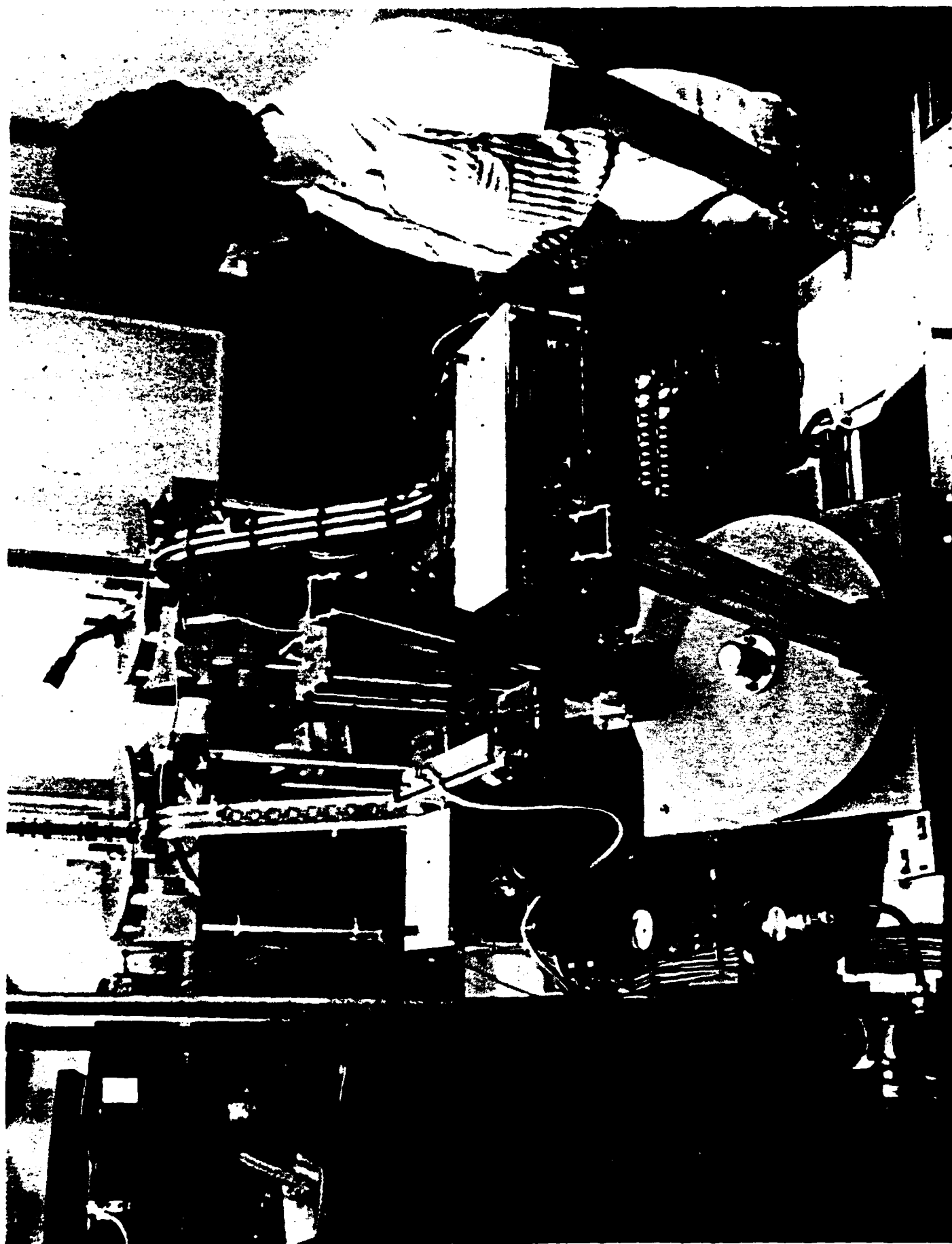
RISI & J. M. Sales Company returned quotations which exceeded any reasonable R.O.I. for the project.

- c. RISI had a sound system approach for forming and loading the carriers. We elected to work with RISI and revise the approach as follows:
 1. Eliminate automated tinning and substitute a hand tinning method for flatpacks and quadpacks.
 2. Develop and alternate method for tinning leadless chip carriers outside the scope of this initial project.
 3. Dispense flatpacks on a tape which could be used to support the parts thru a hand fluxing, tinning and washing process and then permit strip feeding this tape with parts into the forming machine.

INDUSTRIAL TECHNOLOGY MODERNIZATION SURFACE COMPONENT PREPARATION EQUIPMENT



 Delco Systems



SUBCONTRACT PROCUREMENT
STATEMENT OF WORK 421-MD-1929

FLATPACK & QUADPACK FORMING MACHINES

- #1 FLATPACK MACHINE WILL BE IDENTIFIED AS FD-779303
(FOR 1 1/4 SQ. CARRIERS)
- #2 FLATPACK, QUADPACK MACHINE WILL BE IDENTIFIED AS FD-779310
(FOR 2" SQ. CARRIERS)

This Statement of Work incorporates all revisions initiated by Delco Electronics and R.I.S.I. at the Nov. 29, 1984 meeting and replaces all previous work statements.

H. Culver M. Partington
H. Culver & M. Partington
Production Engineering

Otis Lawrence
Approved By: Otis Lawrence
Manager

* Revises Pages 3, 5, 6, 7, 8, 9, 10, 11, 13, 14 & 15

SUBCONTRACT PROCUREMENT
STATEMENT OF WORK 421-MD-1929

1.0 SCOPE

This Statement of Work and associated attachments establishes the requirements for procurement of Flatpack & Quadpack Forming Machines.

2.0 APPLICABLE DOCUMENTS

2.1 General Motors Corporation

GM Basic Electrical Standards for Industrial Equipment, dated April, 1980 and related supplements.

2.2 Delco Electronics

Delco Electronics Specifications for Industrial Equipment, dated May, 1983.

Exceptions to this document for this Work Statement are as follows:

Para. 17.1.1 - Shipping instructions to be obtained from Marv Friebert by calling (414)768-2953.

Para. 18.1.1 - The approving authority at Delco Electronics, Milwaukee is the Work Statement originator. All approval prints, final drawings or reproducibles, requests for deviation and questions concerning this specification shall be addressed to:

Delco Electronics Division
7929 South Howell Avenue
Oak Creek, WI 53154

Attention: Mr. H. Kennedy or
Mr. M. Partington
M/S 1A02

Telephone: (414)768-2339

SUBCONTRACT PROCUREMENT
STATEMENT OF WORK 421-MD-1929

Para. 20.2.1 - Delete reference to requirements of Indiana Law (IC 1971, 22-8-1.1 et. seq.).

On Page 38 under "PROGRAMMABLE CONTROLLERS" delete Modicon.
*Mitsubishi Controllers will be substituted.

2.3 Occupational Safety and Health Act dated 18 October 1972, Part 1910, 219. Mechanical Power Transmission apparatus.

2.4 Attachments to this Statement of Work:

Attachment 1. Requirements for Flatpack & QuadPack Forming Machines.

Attachment 2. Magazine - FB779212, FB779213

Attachment 3. Carrier - FD779169, 779170, 779172, 779173
& 779174

Attachment 4. Tape - WNC-890341

3.0 ARTICLES AND SERVICES TO BE SUPPLIED BY THE CONTRACTOR

3.1 Equipment

- a. Design
- b. Fabrication
- c. Delivery

3.2 Engineering Data

- a. Layout Drawings
- b. Final Drawings
- c. Specifications
- d. Manuals
- e. Spare Parts List
- f. Installation Instructions.

3.3 Progress Information

3.4 Training

SUBCONTRACT PROCUREMENT
STATEMENT OF WORK 421-MD-1929

3.5 Quality Assurance Provisions

3.6 Warranty

3.7 Installation & Checkout Surveillance.

4.0 DESCRIPTION OF ARTICLES & SERVICES

4.1 Equipment

4.1.1 Design - The Subcontractor shall execute all new design and the necessary modification to existing design to meet the requirements of the Attachments to this Statement of Work. Should the Subcontractor have an engineering standard practice on design which conflicts with this Statement of Work, he may submit this standard, provided he states in detail the variance from this Statement of Work. If no exceptions are stated, Delco Electronics will require the Subcontractor to fulfill all details of this Statement of work.

4.1.2 Fabrication - The Subcontractor shall fabricate the Forming Stations per the requirements of Attachment #1 to this Statement of work.

4.1.3 Delivery - The Subcontractor shall be responsible for the packaging and safe delivery of the Forming Stations to Delco Electronics.

4.1.4 The Subcontractor shall act in an advisory capacity during the installation and checkout of the equipment at Delco Electronics. Rate per day and estimated number of days for this effort are stated in the quote.

SUBCONTRACT PROCUREMENT
STATEMENT OF WORK 421-MD-1929

4.1.5 Milestone Chart and Anticipated Machine Implementation Schedule per the Quote.

- a. Release Purchase Order Aug., 1984.
- b. Design Review (4 Mo's after P.O .) Dec, 1984
- c. Fabrication & Assy #1(8 Mo's after P.O.) April, 1985
" " #2(9 Mo's after P.O.) May, 1985
- d. Preliminary acceptance @ Vendor facility
(10 Mo's after P.O.) June, 1985
*Dies will be accepted individually as Fab. is complete.
- e. Installation & checkout @ Delco
(11 Mo's after P.O.) July, 1985
- f. Final acceptance @ Delco
(11 Mo's after P.O.) July, 1985

4.2 Engineering Data

- 4.2.1 A drawing outlining the forming stations showing approximate dimensions, weight, mounting points and requirements for accessibility, operation and maintenance.
- 4.2.2 One reproducible electrical and pneumatic schematic, block diagram and wiring diagram showing selected components and connector pinout.
- 4.2.3 Final Drawings - One set reproducible and one set of non-reproducible drawings of the Forming Stations shall include the following information as a minimum:
 - a. Parts List - including generic part numbers where applicable.
 - b. Electrical, pneumatic and hydraulic schematics.
 - c. Cable and wire list.
 - d. Modifications made to purchased commercial equipment.
 - *e. Assemblies, subassemblies, details & system interface.

*Proprietary information will not be provided, but sufficient information to permit maintenance and servicing to the component level will be provided.
- 4.2.4 Operation and Maintenance Manuals - The Subcontractor shall generate and submit two copies to Delco Electronics of an OPERATION and MAINTENANCE MANUAL which shall be suitable for

SUBCONTRACT PROCUREMENT
STATEMENT OF WORK 421-MD-1929

use by skilled technical level personnel in the repair, maintenance and the operation of the Forming Stations.

The MAINTENANCE MANUAL shall contain sufficient information to permit servicing down to the component level. Standard Maintenance Manuals on unmodified commercially available equipment is adequate.

- 4.2.5 Spare Parts List - The Subcontractor shall submit one list of recommended spare parts. Quantities listed shall be sufficient to support one piece of equipment for one year.
*Spares list will include the Mitsubishi "Controller Programmer".

- 4.2.6 Installation Instructions - The Subcontractor shall submit installation drawings defining utilities and special installation requirements.

4.3 Training - Not Applicable

4.4 Quality Assurance Provisions

- 4.4.1 Notification of Readiness for Acceptance - The Subcontractor shall notify Delco Electronics of readiness of the Forming Stations for acceptance. This notification shall be given at least five (5) days before the scheduled acceptance start date. Notice of cancellation or change of an acceptance date shall be given at least two (2) days in advance of any scheduled acceptance date.

- 4.4.2 Preliminary Acceptance - Preliminary acceptance of the Forming Stations shall be accomplished at the Subcontractor's facility. A functional demonstration in compliance with the requirements of this Statement of work shall be conducted in the presence of authorized Delco Electronics representatives. Acceptance shall be based on successfully forming 500 pieces total which reflect the part variations specified in this S.O.W.

*NOTE: Dies will be accepted individually at the vendors facility as follows:

- a. Delco will provide tinned parts (ten minimum) to R.I.S.I. for forming for each die configuration.
- b. Parts will be formed by R.I.S.I. and shipped to Delco.
- c. Delco will inspect and verify the formed parts to the forming specification in this S.O.W.

SUBCONTRACT PROCUREMENT
STATEMENT OF WORK 421-MD-1929

- d. Acceptance of the individual dies will be based on compliance to the forming specification. Die invoices will be paid on P/N's FD779304 thru FD779309 and FD779311 thru FD779316 based on this acceptance criteria.
- e. Final acceptance of the machines (FD779303 and FD779310) with anyone of the above dies will be accordance with Para. 4.4.1, 4.4.2 and 4.4.3.

4.4.3 Final Acceptance - Final acceptance of the Forming Stations shall be accomplished at Delco Electronics and shall be based on demonstration of compliance with the requirements of this Statement of Work. A final acceptance shall be conducted in the presence of authorized Delco Electronics representatives. Acceptance shall be based on successfully forming 1,000 pieces total which reflect the part variations specified in this S.O.W.

4.4.4 Equipment Verification - The Subcontractor shall maintain technical liaison with Delco Electronics to correct deficiencies and/or to effect improvements in the operation and design of the equipment during the warranty period, as stated in the quote.

5.0 SUGGESTED METHOD OF ANSWERING THIS STATEMENT OF WORK AS DESIGN & FABRICATION PROGRESSES:

- 5.1 Indicate either compliance or deviation and alternate specification in response, as required, to all numbers of this work Statement and Attachments thereto. Follow this same procedure on the GM Electrical Standards.

6.0 MAILING INSTRUCTION

The mailing address for documentation, reports and notices shall be as follows:

Delco Electronics Division
General Motors Corporation
P.O. Box 471
Milwaukee, WI 53201

Attn: Mr. John Lukomski
Dept. 417, M/S 1A09

cc: Mr. Mike Partington
Dept. 421, M/S 1A02

SUBCONTRACT PROCUREMENT
STATEMENT OF WORK 421-MD-1929

ATTACHMNT 1

REQUIREMENTS FOR THE FORMING STATIONS:

INTRODUCTION:

Two seperate machines will be provided.

- A. FD-779303 will feed parts from a Magazine with the parts in 1 1/4 square carriers, or a tape feeder with the parts on tape, or permit hand loading bare parts. Machine will form and cut Flatpacks with 10 to 28 leads, load them in a carrier and reload in a Magazine. *Palm interlock safety buttons will be provided for "hand operation".
- B. FD-779310 will feed parts from a Magazine with the parts in 2" square carriers, or a tape feeder with the parts on tape, or permit hand loading bare parts. Machine will form and cut Flatpacks with 42 leads and Quadpacks with 64 to 132 leads, load them in a carrier and reload in a Magazine. *Palm interlock safety buttons will be provided for "hand operation".

MACHINE #1 - FD-779303 (Flatpacks up to 28 leads):

- 1.0 Tape Feeder: Tape feeder will be usable on both machine #1 & #2. One tape feeder is required and will be shared with both machines. Tape feeder assembly will be identified as FD-778845.
- 1.1 Flatpacks attached to Mylar strips used for the lead tinning process, will be placed on the input station by the operator.
- 1.2 The system will allow the operator to place one strip at a time at input. Tape is described by Delco P/N WNC-890341, Rev. C.
- 1.3 The strips will be as wide as the nominal body size, or always narrower than the maximum body width, so as not to interfere with the forming operation.
- 1.4 Glue will not extend beyond the body between each device, nor outside the width of the strip.
- 1.5 Flatpacks with 10 & 14 leads will be attached to a strip on .500" centers.

SUBCONTRACT PROCUREMENT
STATEMENT OF WORK 421-MD-1929

- 1.6 Flatpacks with 10, 14 & 16 leads will be attached to a strip on .600" centers.
- 1.7 Flatpacks with 20, 24 & 28 leads will be attached to a strip on .825" centers.
- 1.8 Flatpacks with 42 leads will be attached to a strip on a 1.240" centers. (Applicable to MACHINE #2.)
- 1.9 Flatpacks will be attached to the strip with sufficient accuracy to allow insertion into in-house carriers after forming. Accuracy of placement is also necessary for placement in dies.
- 1.10 Mylar strips will have tooling holes between each component as well as before the first and after the last on .500", .600", .825" and 1.240" centers.
- 1.11 Mylar strips will have 2 holes on 7.00" centers with one hole constant at 1.000 from the ϵ of the first part for polarity keying.
- 1.12 The strips will be automatically indexed by the machine input station into position for pickup. Quick-change tooling will be provided to alter pitch.
- 1.13 The Mylar strip will be cut between the Flatpack in the pick-up position and the next one out.
- 1.14 The Flatpack in pickup position will be placed in a prepositioner and then placed in the die station by the machine pickup arm and held in position while formed.
- 1.15 The formed part will be released by the forward vacuum quill on the pickup arm and held in the die by vacuum from the bottom.
- 1.16 As the pickup arm advances to pickup another part cut from the strip, the rear vacuum quill will retrieve the Flatpack from the die.
- 1.17 As the next part is placed in the die, the flatpack held by the rear vacuum transfers the formed part back and places it into an in-house carrier.
- 1.18 Empty in-house carriers will be automatically fed from a Magazine and detented in place at output.
*Bowl for the empty carrier feeder (replaced in this design with a magazine feeder) will be shipped to Delco as a loose item.

SUBCONTRACT PROCUREMENT
STATEMENT OF WORK 421-MD-1929

- 1.19 In-house carrier will be 1 1/4" x 1 1/4" outline and will have a hole in the bottom center to allow a vacuum plunger to emerge and hold the Flatpack in place as the pickup vacuum is released. 1 1/4" carriers are identified by Delco drawings for FD-779169, FD-779170, FD-779172 and 2" carriers for Machine #2 are FD-779173 and FD-779174. NOTE: FD-779171 is not used.
- 1.20 Loaded carriers will be stacked into a vertical magazine.
- 1.21 The magazine loader will hold at least two manually indexed magazines.
- *1.22 The machine will stop when a Magazine is full or the last part formed in a "lot" has been loaded into a magazine.
- *1.23 The operator will remove full magazines (or magazines with a specific number of parts) and replace with empty.
- 1.24 The tape feeder-cutter is removable and the machine can be fed automatically from a Magazine with parts in 1 1/4" square carriers.
- 1.25 Machine may also be hand fed with parts one at a time by the operator.

MACHINE #2 - FD-779310 (42 Pin Flatpacks and Large Quadpacks):

- 2.0 Machine #2 will function identically the same as Machine #1 except the Magazine feeders and Magazine Loader will utilize 2" square carriers.
- 2.1 The tape feeder described above is usable on this machine for Flatpacks with 42 leads that will be attached to a strip on 1.240" centers.

NOTE: Original S.O.W. & Quote contained a "Stack Feeder" for Quadpacks in a tinning fixture. This "Stack Feeder" has been eliminated and replaced with capability to hand feed Quadpacks one at a time.

FORMING DIES:

- 3.0 The forming dies will control the "formed foot height" with respect to the bottom surface of the part.
- 3.1 The formed foot height will be adjustable from "flush" to .050" below the part bottom in increments of .001". Height adjustment will be thumb wheel type adjustment. The thumb wheel will be marked in graduations of .001".

SUBCONTRACT PROCUREMENT
STATEMENT OF WORK 421-MD-1929

*Note 1: Deleted

Note 2: The forming dies are "quick-change". Changeover from one die to another takes approximately 3 minutes.

3.2 Forming specifications are noted below for each die. Each die is identified with a separate "FD" part number. Die part numbers FD-779304 thru FD-779309 are interchangeable on Machine #1, FD-779303. Die part numbers FD-779311 thru FD-779316 are interchangeable on Machine #2, FD-779310.

3.3 FORMING SPECIFICATIONS:

P/N	B	C MAX	H	I	R	# OF LEADS	T
FD779304	.400	.280	0/.050	.035	.005	10/14	.005 ± .001"
FD779305	.445	.305	0/.050	.040	.005/2T	10/14/16	.005 ± .001"
FD779306	.495	.305	0/.050	.040	.005/2T	10/14/16	.005 ± .001"
FD779307	.595	.440	0/.050	.040	.005/2T	20/24/28	.005 ± .001"
FD779308	.661	.515	0/.050	.040	.005/2T	20/24/28	.005 ± .001"
FD779309	.695	.515	0/.050	.040	.005/2T	20/24/28	.005 ± .001"
				+ .003 - .002			
FD779311	1.095	.660	0/.050	.040	.005/2T	42	.009 ± .001"
FD779316	1.115	.960	0/.050	.040	.005/2T	132	.005 ± .001"
FD779312	1.161	.660	0/.050	.040	.005/2T	42	.009 ± .001"
FD779313	1.161	.965	0/.050	.040	.005/2T	64	.010 ± .001"
FD779314	1.161	.965	0/.050	.040	.005/2T	68	.010 ± .002"
FD779315	1.195	.965	0/.050	.040	.005/2T	68	.010 ± .002"

- NOTES:
1. All values of "R" are for radius of knee bend. Heel bend radius for all forms to be .005.
 2. Lead form from case to knee bend must be flat .010" minimum when B=.400 and flat .015" minimum for all other B dimensions.
 3. Tolerances on "B" ± .005 for "H" up to .030" and
- .005
+ .015 for "H" greater than .030"

SUBCONTRACT PROCUREMENT
STATEMENT OF WORK 421-MD-1929

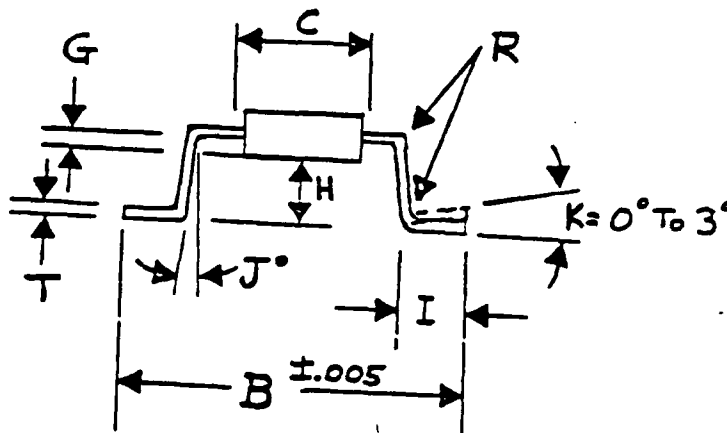
4. Bottom to lead "G" dimensions are as follows for Spring Back Calculation:

# of Leads	"G"
10-64	.020 to .040
68	.065 \pm .006
132	.075 \pm .006

5. "K" dimension shall provide a 0° to 3° upward bend on the lead foot.
6. As a reference point, "J" angle, with variation of "G" will be as noted below. In all cases, "B" dimension will be within the tolerance specified.

	"G"	"H"	"T"	"J" MAX
a.	.005	.008	.005 =	3°
b.	.030	.008	.005 =	6°

7. Symmetry of body to "B" dimension will be $\pm .005$ "



SUBCONTRACT PROCUREMENT
STATEMENT OF WORK 421-MD-1929

4.0 MISC. ITEMS AND REQUIREMENTS:

4.1 Cycle Time:

Machine #1

Magazine to Magazine - 6 seconds maximum
Tape Fed Part to Magazine - 12 seconds maximum

Machine #2

Magazine to Magazine - 6 seconds maximum
Tape Fed Parts to Magazine - 12 seconds maximum

4.2 This quote is for equipment F.O.B. IMD's plant in Chula Vista, California. Freight and Insurance have not been included.

4.3 IMD will act in an advisory capacity during the installation and checkout of the equipment. Rate per day is quoted below. Duration is estimated at one week maximum (partial deliveries may increase this, but not appreciably).

4.4 IMD will control the equipment with a Mitsubishi F-40 Programmable Controller, as used on IMD's standard Model 1140.

4.5 Exterior finish of all equipment shall be "standard" finish provided by IMD.

5.0 PRICING DESCRIBED IN THE QUOTATION:

<u>P/N</u>	<u>QTY</u>	<u>UNIT PRICE</u>
1.FD-779303	1 Flatpack Forming Station, as described including tape feeder FD-778845	\$ 69,379
2.FD-779310	1 Large Flatpack and Quadpack Forming Station, as described.	\$ 75,210
3.FD-779304 thru 779309	6 Forming dies for Flatpacks with up to 28 leads.	\$ 6,985 each
4.FD-779311 and 779312	2 Forming dies for 42 pin Flatpacks	\$ 7,850 each
5.FD-779313 thru 779316	4 Forming dies for Quadpacks	\$ 9,785 each
*6.Non-recurring	- Engineering, design and drafting	\$ <u>30,960</u>

*Sub-total of effort on original P.O.= \$ 272,299

SUBCONTRACT PROCUREMENT
STATEMENT OF WORK 421-MD-1929

*Cost revisions based on this S.O.W. as revised 12/03/84:

*7. Bowl feeder and base, 24", originally used on machine #1 - to be shipped as a separate item. \$6,053.00

*8. Revisions to machine #1, FD779303:

- a. Palm safety buttons for manual operation \$ 847.00
- b. "Pusher" addition to load last part formed into the magazine. \$ 2,982.00
- c. Provide magazine feed for empty carriers, magazine feed for full carriers, singulators, pre-positioners, transfer station and necessary controls for 1 1/4 carriers with chips up to 28 leads. \$22,102.00

*9. Revisions to Machine #2, FD779310:

- a. Provide Palm Safety buttons for manual operation, magazine feed for full carriers, singular, pre-positioner, transfer station and necessary controls for 2" carriers with chips over 28 leads. Delete requirement for a Quadpack tinning fixture feeder. - \$ 17,506.00
- b. Provide "Pusher" addition to load last part formed into the magazine. \$ 1,200.00

*10. Revise two separate mylar strip feeders to "one" interchangeable strip feeder usable in place of "full carrier magazine feeders" on both machine #1 and #2. \$ 739.00

REVISED TOTAL AUTHORIZED BY THIS S.O.W. (ITEMS 1 THRU 10) = \$323,728.00

*11. The following items to be added as required by Delco at the following rates:

- a. Installation and check-out at DELCO \$ 465.00
per day +
air fare, meals & accomodation
- b. Equipment Verification \$ 465.00
per day +
air fare, meals & accomodation

*12. Payment Terms:

- a. Design approval (Paid Nov. '84) - Item 6 above = \$ 30,960.00
- b. Payment at rates specified in items 3, 4 & 5 above for

SUBCONTRACT PROCUREMENT
STATEMENT OF WORK 421-MD-1929

individual dies as accepted per note in Para. 4.4.2.

- c. 25% value of items 1, 2, 7, 8, 9 & 10 above on completion and preliminary acceptance at IMD per Para. 4.4.1 and 4.4.2.
- d. Balance on final acceptance at Delco per Para. 4.4.3.

